Philosophical Transactions

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under which lay thofe before-mention'd Jaw-bone, and Piece of Horn; which, in all Appearance, to every one that viewed thefe *Stratums*, had never been removed.

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M. C.

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Dimenfions of the Deers Horns in the Mufæum *of the* ROYAL SOCIETY.

	Feet	Inches.
Length of the Skull	1	4
Breadth of the Forehead	0	9
Length of each Horn	5	0
Diftance of the extreme Tips of the Horns	6	0

N. B. Thefe Horns (*Fig.* 2.) are evidently of the fame fort as thofe often found in *Ireland*, of which Defcriptions are given in *Tranfact.* *n.* 227, *n.* 394. and *n.* 414, *p.* 389. But I do not remember to have met with any before of this Species found in *England*, or any-where elfe befides *Ireland*.   *C. M.*

VI. *The Phænomena of* Venus, *reprefented in an Orrery made by Mr.* James Fergufon, *agreeable to the Obfervations of Seignior* Bianchini.

Read March 20. 1745-6. *here printed with Alterations.* IN all the Orreries that I have feen, *Venus* is reprefented as having her *Axis* perpendicular to the Plane of the Ecliptic, and her diurnal Motion thereon equal to 23 Hours of our terreftrial Time. Hence, as her annual Motion is performed in about 225 of our Days, it will contain 234 of hers; confequently, to an Eye placed in *Venus*, the Sun will always appear to go

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thro' a Sign of the Zodiac in $19\frac{1}{2}$ of her Days; and as her *Axis* has no Inclination, she must have a continual Equality of her Days and Nights, without any Variation of Seasons, and so her annual Motion can be of no other Use than to keep her from falling down to the Sun.

But *Bianchini* gives a very different Account of her; which is, that her *Axis* inclines 75 Degrees from a Line supposed to be drawn perpendicular to the Plane of the Ecliptic (by which I suppose he means her own Ecliptic, and not the Earth's) ; and that her diurnal Motion is performed in 24 Days and 8 Hours of our Time ; and this will cause her Year, which is equal to almost 225 of our Days, to contain only $9\frac{1}{4}$ of her Days; and this odd Quarter of a Day in *Venus* will make every fourth Year a Leap Year to her, as happens to us on Earth, by the 6 Hours that our Year contains above 365 Days: And to her the Sun will appear always to go thro' a Sign of the Zodiac in little more than $\frac{3}{4}$ of her Day, which is equal to $18\frac{1}{4}$ of our Days ; and in going round the Sun, her North Pole constantly leans towards the 20th Degree of *Aquarius*.

Thus, with regard to the absolute Length of *Venus*'s Year, *Bianchini* agrees with *Caffini* and other Astronomers : but differs widely in other very remarkable Particulars, from which arise so many Advantages, as to make that Planet incomparably more fit for its Inhabitants, than we could possibly conceive it to be by a quick Rotation on an *Axis* perpendicular to its annual Path. For *Venus* is so much nearer the Sun than our Earth is, that it is well known she must have twice as much Light and Heat as our Earth has ;

and

and' then, was the Sun always perpendicularly above her Equator, we cannot imagine but that her Equatorial Parts muſt be burnt up with Heat, and her Polar Parts uninhabitable, by reaſon of the Greatneſs of Cold, occaſioned by the Sun-beams being parallel to, or making ſo very acute Angles with, the Horizon.

But, by ſuch a Motion as *Bianchini* deſcribes, and which I have exactly repreſented in my Orrery, theſe Inconveniences are avoided ; for there is no Place in *Venus* but what will have the four Seaſons every Year, and the heated Places will have Time to cool ; becauſe, to any Place over which the Sun paſſes vertically on any given Day, he will, on the next Day, be 26 Degrees from the *Vertex* thereof, even tho' the Place be on the Tropic ; and if it be on the Equator, One Day's Declination will remove him $37\frac{1}{3}$ Degrees from it.

I having conſidered in general what the Effects of the Sun's quick and great Declination would be in *Venus*, as occaſioned by the great Inclination of her *Axis*, with her ſlow diurnal and quick annual Motion ; and finding that her Globe in the Orrery, by being not quite an Inch in Diameter, was inſufficient for ſolving her *Phænomena* to any Degree of Exactneſs ; I took the following Method, by which I could do it mechanically, to ſerve my Purpoſe.

Along the Middle of a ſtrait narrow Slip of Parchment I drew a black Line, and then meaſuring my Parchment round a common Globe of 9 Inches Diameter, cutting it ſo as when the Ends were a little overlapp'd, it would become a Girdle, and ſtick faſt on any great Circle of the Globe. Having thus fit-

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ted it, I took it off; and laying it flat on a Table, I divided one Side of the black Line into 9¼ equal Parts for the 9 Days and Quarter of a Day in *Venus's* Year, and then I subdivided each Day into 24 Hours or equal Parts, of which the odd Quarter contained 6, and set the proper Figures to them. The other Side of the Line I divided into 12 equal Parts or Signs, and each Sign into 30 Degrees: By this means I could easily see, at every Day and Hour in *Venus*, in what Place of the Ecliptic the Sun was: And putting this Girdle round the Globe, at an Angle of 75 Degrees to the Equator, crossing it in two opposite Points, it would, by representing *Venus's* Ecliptic drawn on her Globe, serve for the Solution of Problems concerning her, as the Ecliptic on our terrestrial Globe does for those relating to our Earth: For, by bringing the Sun's Place, at any Day or Hour, to the brasen Meridian, I had thereby his Declination for that time; which gave me both an easy and sure Way for drawing the Spiral of the Sun's Motion over the Body of *Venus* on this Globe; and then, by elevating it to different Latitudes, I could immediately see where the Spirals cut the Horizon in any Latitude, and at what Height or Declination they cross'd the Meridian; as by the Hour-Circle I could easily perceive the Times of the Sun's Rising and Setting, and his Amplitudes on the Horizon; and I called that the first Meridian, which passed thro' the Northern Tropic, in the Place where the Sun touch'd it at his greatest North Declination; reckoning the East or West Longitudes on the Equator from that Meridian. But this Meridian will only serve for One Year; because, as the odd Quarter of a Day in *Venus* causes the Sun to cross

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her Equator 90 Degrees Weftward of the former
Place every Year, the Place of the Sun's greateft De-
clination at the North Tropic will be in a Meridian
90 Degrees Weftward of the former alfo. Things
being thus premis'd in general : I now proceed to give
as good a Defcription as I can of the particular *Phæ-
nomena* in *Venus*, confining myfelf chiefly to what
happens in her Northern Hemifphere ; knowing that
the fame muft happen, *mutatis mutandis*, in the
Southern.

1. Her *Axis* is inclined 51½ Degrees more than the
Axis of our Earth, and therefore the Variation of
her Seafons will be much greater than of ours.

2. Becaufe her North Pole inclines toward *Aqua-
rius*, and ours to *Cancer*; her Northern Parts will
have Summer in the Signs where thofe of our Earth
have Winter ; and *vice verfa*.

3. The artificial Day at each of her Poles (con-
taining 4⅛ apparent diurnal Revolutions of the Sun)
will be equal to 112½ natural Days on our Earth.

4. The Sun's greateft Declination, on each Side of
her Equator, amounts to 75 Degrees : Therefore her
Tropics are only 15 Degrees from her Poles, and her
Polar Circles at the fame Diftance from her Equator.
Confequently, her Tropics are between her Polar Cir-
cles and Poles, contrary to what thofe on our Earth
are.

6. The Sun, in one apparent diurnal Revolution
from the Equator, and any Meridian where he croffes
it, to the fame Meridian again, changes his Declina-
tion at leaft 14 Degrees more on *Venus*, than on our
Earth from the Equinox to the Solftice.

6. Let us now suppose an Inhabitant standing on her North Pole, where the Sun's Declination is always the same with his Altitude, and looking toward that Point of the Horizon where the first Meridian (above-mentioned) cuts it; and let him call that Point the South, so shall he have a Meridian fixt, which will determine the other cardinal Points on the Horizon; tho', strictly speaking, every Point of the Horizon to him is South: Yet, for once, let us suppose him to have an horizontal Plane, fixed with its South Point in this Meridian, and thence divided and numbered like the Horizon of a Globe: Put a moveable Ruler with Sights to turn round the Centre of this Plane, for observing the Sun's Amplitude at Rising and Setting; and a graduated Quadrant to be fixed in the North and South Line, with a moveable Index, for taking the Sun's Altitude, in passing over the Meridian. The same Degree, or Part of a Degree, that gives him the Altitude, will also give him its Declination, and he will have the following *Phænomena.*

The Sun will rise $22\frac{1}{2}$ Degrees North of the East, and going on $112\frac{1}{2}$ Degrees, as measured on the hozontal Plane, he will cross the Meridian at an Altitude of $12\frac{1}{2}$ Degrees; then, making an intire Revolution without setting, he will cross it again at an Altitude of $48\frac{1}{2}$ Degrees: At the next Revolution he will cross it as he culminates, at the Height of 75 Degrees, being only 15 Degrees from the *Zenith*; and thence he will descend in the like spiral manner, crossing the Meridian first at an Altitude of $48\frac{1}{2}$ Degrees; then, at an Altitude of $12\frac{1}{2}$ Degrees, and going on thence $112\frac{1}{2}$ Degrees he will set $22\frac{1}{2}$ Degrees North of the West, having been 4 Revolutions and and ⁵ Parts of One above the Horizon.

7. If the Spectator turns his Instrument $22\frac{1}{2}$ Degrees toward the East, and then suppofes his Quadrant in the Plane a new Meridian to him; the Sun will then rife due East, and fet in the North-West; and his Declination in the Meridian will not be the fame as before; for he will firft crofs it at an Altitude of 10 Degrees: next of 46; then, of $74\frac{6}{8}$; and, at an Hour and an half after, he will come to his greateft Declination; from which, in his Defcent, he will not crofs the Meridian in the fame Degrees of Altitude, as in afcending he did.

8. Now, let the Spectator turn his Instrument 90 Degrees ftill more toward the East, and the Sun will rife due South; and from thence making a complete Revolution, he will crofs the Meridian at an Altitude of $37\frac{1}{2}$ Degrees; making another Revolution, he will crofs it at an Altitude of $70\frac{3}{4}$ Degrees; and, going on $7\frac{1}{2}$ Hours (or 112 Degrees) he comes to his greateft Declination in the Weft-North-Weft: Thence defcending, at the End of the third Revolution he croffes the Meridian $58\frac{1}{3}$ Degrees high; at the End of the fourth he crofles it in $23\frac{3}{4}$ Degrees of Altitude; and, going on thence 225 Degrees, or $\frac{5}{8}$ of a Revolution, he fets in the North-Eaft,

9. If the Spectator will now turn his Instrument juft half round, fhifting his Meridian 180 Degrees, the Sun will rife in the North; and, going on 180 Degrees, or half a Revolution, he will crofs the Meridian at an Altitude of 19 Degrees; then, making a complete Revolution, he will crofs it at an Altitude of 55 Degrees; and, going on thence $292\frac{1}{2}$ Degrees he comes to his greateft Declination in the Eaft-South-Eaft; from which Place he defcends, croffing the Meridian in $73\frac{1}{2}$ Degrees of Altitude; and, in the next Revolution, he croffes the

7   Meridian

Meridian at an Altitude of $41\frac{1}{2}$ Degrees: At the fourth Revolution he crosses it at an Altitude of 5 Degrees; and going on thence 45 Degrees, or $\frac{1}{8}$ of a Revolution, he sets in the South-West.

10. The Sun being thus for half a Year together above each Pole of *Venus* in its Turn, will cause the whole Year at her Poles, as well as at the Poles of our Earth, to contain only one Day and one Night: But there, the Difference between the Heat in Summer and Cold in Winter (or of Mid-day and Midnight) is greater than betwixt the same on any two Places of our Earth; because, in *Venus*, the Sun is for half a Year together above the Horizon of one or other of the Poles ; and for at least $\frac{2}{3}$ of a Revolution (or about 16 of our Days) within 20 Degrees of the *Zenith* ; and during the other Half of the Year, always below the Horizon ; and for a confiderable Part of that Time, at least 70 Degrees from it : Whereas at the Poles of our Earth, tho' the Sun is for half a Year together above the Horizon, yet his Altitude is never more than $23\frac{1}{2}$ Degrees above it in Summer, nor his Depreffion greater than that Quantity below it in Winter. When the Sun is in the Equator, he is feen in the Horizon of both Poles ; one Half of his Difc above, and the other below : And defcending quite below the Horizon of one Pole, he afcends in a vifible Spiral above that of the other, until he comes within 16 Degrees of the *Zenith*, where he keeps the fame Altitude nearly for fome time ; then defcends in the like fpiral manner, till he gets below the Horizon, where he continues invifible for the other Half of the Year. This will occafion to each Pole one Spring, one Harveft, a Summer as long as them both, and

and one Winter, equal in Length to the other three Seasons.

The Sun's great Distance below the Horizon of *Venus*'s Poles, will make her Winters much more uncomfortable than at the Poles of our Earth, where they have Twilight more than half the Winter-time; unless she be surrounded with an Atmosphere capable of occasioning a Twilight, at least as long in proportion to her Winter, as our Twilight is to ours. But this can hardly be suppos'd; because always, when we see *Venus*, she appears with the same constant Serenity; and therefore I am apt to beleive she has a Satellite, to supply, in some measure, the Absence of the Sun; as our Moon does to our Earth's Poles, for one Half of the Winter constantly, without setting, from the first to the third Quarter. 'Tis true, that we are inconveniently posited, with regard to *Venus* for seeing her Satellite (if she has one); because, when her Moon or Satellite has its enlighten'd Side toward us, it may be too far distant to be seen, because *Venus* is then beyond the Sun, and, consequently, furthest from us; and when she is betwixt us and the Sun, or thereabouts, her full Moon would have its dark Side to us: And tho' *Venus* be then nearest the Earth, yet her Satellite could no more be seen by us, than we can see our own Moon at her Conjunction. When *Venus* is at her greatest Elongation, we should have only one Half of the enlighten'd Side of her full Moon turn'd towards us; and even then, perhaps, on account of its Smallness, it may be too far distant to be seen by our Telescopes. But of this only by-the-bye.

11. At the Tropics, the Sun in Summer will continue for about 15 of our Weeks together above the

S   Horizon

Horizon without fetting, and as long below it in Win-
ter without rifing. While he is more than 15 De-
grees from the Equator, he neither fets to the Inha-
bitants of the nearest Tropic, nor fets to thofe of the
other ; whereas, at our terreftrial Tropics, he rifes and
fets every Day in the Year. But to let us know more
particularly the *Phænomena* of *Venus's* Tropics, we
will fuppofe the Inhabitant, who has feen the above-
mention'd Appearances at the North Pole, to have
travell'd thence along the firft Meridian 15 Degrees
to the Northern Tropic, carrying his Engine or In-
ftrument along with him ; and to have fet it due
North and South, in the Place where the faid Meri-
dian interfects the Tropic ; and as the Meridian of
every Place is in a great Circle paffing thro' the *Zenith*
of the Place and both Poles, he can now be at no
Lofs how to fettle his Meridian, and obferve as well
the Amplitude and Azimuth, as the Altitude of the
Sun ; who will rife to him 10 Degrees North of the
Eaft, with about one Degree of North Declination :
And going on 100 Degrees (to be meafured on the
horizontal Plane) he will crofs the Meridian with
12½ Degrees of North Declination, and 27½ of Alti-
tude ; then, making an intire Revolution without
fetting, he will crofs the Meridian at 48½ Degrees of
Declination, and 63½ of Altitude : At the End of the
next Revolution, he will crofs the Meridian in the
Zenith at the greateft Declination ; namely, 75 De-
grees ; and thence he defcends in the like Spiral,
croffing the Meridian at the fame Altitudes as above,
till, in his fifth Revolution, he fets 10 Degrees North
of the Weft.

12. Let our Traveller now remove Weſtward on the ſame Tropic, to a Meridian $97\frac{1}{2}$ Degrees diſtant from the firſt ; and there he will have very great Differences of the Riſing, Setting, and Meridian Altitude of the Sun ; which will now riſe to him the firſt time, in the South Point of his Horizon, at 12 o'Clock ; at 1 o'Clock he will be about half a Degree above the Horizon, and will ſet at 2 o'Clock : So this ſhort artificial Day in *Venus* (which is ſomewhat longer than two natural Days on our Earth) will have no Forenoon at all. The Sun, after continuing almoſt 14 of *Venus*'s Hours below the Horizon, ſuppoſing each diurnal Rotation to be divided into 24 Hours, will riſe a little before 4 o'Clock next Morning, near the North-Eaſt ; and, going on 130 Degrees, he will then croſs the Meridian with 22 Degrees of North Declination, and 37 of Altitude : Then, going on without ſetting, he again croſſes the Meridian at 57 Degrees of Declination, and 72 of Altitude ; and advǎncing forward thence $17\frac{1}{2}$ Hours, or $262\frac{1}{2}$ Degrees, he comes to his greateſt Declination, $7\frac{1}{2}$ Degrees to the North of the Eaſt : From thence, completing his Revolution to the Meridian, he now croſſes it in $71\frac{1}{2}$ Degrees of Declination, being only $3\frac{1}{2}$ Degrees from the *Zenith :* At the next Revolution he croſſes the Meridian with $38\frac{1}{2}$ Degrees Declination, and $53\frac{1}{2}$ of Altitude : At the next, which is the fourth Revolution, he croſſes the Meridian with $1\frac{1}{2}$ Degree of Declination, and $16\frac{1}{2}$ Degrees of Altitude ; and then goes on 65 Degrees, and ſets near the Weſt South-Weſt.

13. Suppoſe now that our Traveller removes ſtill further Weſtward, on the ſame Tropic, to a Meri-

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dian 105 Degrees diftant from this his fecond Station
and then the Sun will firft rife to him in the South
Eaft about 9 o'Clock; and going on thence 45 De
grees, he will crofs the Meridian with 6 Degrees of
South Declination, and 9 of Altitude, at 12: About
2 o'Clock he will be a Degree higher; and, thence
defcending, he will fet near the North Weft a litt'e
before 9 o'Clock: So the Afternoon of this Day
is almoft 6 Hours (about 6 natural Days with us)
longer than the Forenoon; and its Night is but little
more than 3 Hours long: For the Sun, after going
a little below the Horizon, rifes in the North Point
thereof; and, making half a Revolution, he croffes
the Meridian with 33 Degrees of Declination, and
48 of Altitude; thence, making a whole Revolution,
he croffes the Meridian at 66 Degrees of Declination,
and 81 of Altitude: At the next Revolution his De-
clination is 63 Degrees (having paffed the greateft 14
Hours before): At the next, it is 28 Degrees of Decli-
nation; and, going on thence about 146 Degrees, he fets
North Weft-by-North, about half an Hour after 9 o'
Clock; and continues invifible till 3 Quarters paft 5
in the next Morning, when he rifes about 4 Degrees
North of the Eaft; and, going thence forward 94
Degrees, he croffes the Meridian about 5 Degrees Al-
titude, and 10 of South Declination, having kept
the fame Altitude very nearly for three Hours;
then defcending, he fets in the South-South-Weft,
about half an Hour paft 1 o' Clock; which makes
the Afternoon 5 Hours and about 12 Minutes fhorter
than the Forenoon of the fame Day. The Sun now
fets for about 15 of our Weeks to *Venus*'s Northern
Tropic, and rifes to the Southern; in which the
Phænomena

Phænomena are the fame: Each Tropic having the four Seafons once every Year; the Winters being longer than the Summers, tho' not quite fo long, in proportion, as at the Poles.

14. Having faid fo much concerning the North Pole and Tropic, proceed we now to ftation our Inhabitant in a Place of 45 Degrees of North Latitude, where the firft Meridian cuts the Parallel, and he will have the following *Phænomena.*

The Sun will rife 43 Degrees Eaft of the South, a little before 9 o' Clock; and, afcending very quickly, he will, in little more than 3 Hours, crofs the Meridian at an Altitude of 19 Degrees, with 26 Degrees of South Declination; then going on 62 Degrees, he will fet near the Weft-South-Weft about 5 o' Clock in the Afternoon; by which means it is almoft two Hours longer than the Fore-noon; each Hour in *Venus* being equal in Length to 24 Hours and 20 Minutes of our terreftrial Time. The next Day the Sun will rife 3 Degrees North of the Eaft, about half an Hour paft 5 o' Clock in the Morning, and will crofs the Meridian with $12\frac{1}{2}$ Degrees of North Declination, and $57\frac{1}{2}$ of Altitude; and will fet in the North-Weft-by-Weft, about half an Hour paft 7 o' Clock: So that the Afternoon will be 2 Hours longer than the Forenoon. The next Day the Sun rifes 53 Degrees North of the Eaft, about 3 o' Clock; and will crofs the Meridian $3\frac{1}{2}$ Degrees North of the *Zenith*; or with $86\frac{1}{2}$ Degrees of North Altitude, and $48\frac{1}{2}$ of Declination: Then he goes round without Setting; and croffes the Meridian 30 Degrees North of the *Zenith*, where he comes to his greateft Declination; from which he returns in the like Spiral toward the Equator,

Equator, and beyond it; but will not rife and fet at the fame Hours as before: For, having made a Revolution without Setting, in the next he fets 53 Degrees North of the Weft, about 9 o'Clock: Next Morning he rifes in the North-Eaft-by-Eaft, about half an Hour paft 4 o' Clock; croffes the Meridian with 12½ Degrees of Declination, and fets 3 Degrees North of the Weft, about half an Hour paft 6; and now the Forenoon is 2 Hours longer than the Afternoon. The next Day the Sun rifes about 7 o' Clock, 62 Degrees Eaft of the South; paffes over the Meridian at an Altitude of 19 Degrees, with 26 Degrees of South Declination; and fets a little after 3 o' Clock; which makes the Forenoon to be about 2 Hours at leaft longer than the Afternoon: And now the Sun will continue below the Horizon at leaft 12 of our Weeks without rifing to this Inhabitant of *Venus*.

15. In this Place of *Venus* the Hour and Amplitude of the Sun's Rifing, for one Half of the Year, are the fame with thofe of his Setting in the other Half; which will alfo happen in all Places under the firft Meridian, where he rifes and fets: But, if our Spectator pleafes to remove along the Parallel of 45 Degrees Latitude, Eaftward 142 Degrees, the *Phænomena* of Things will then be very different to him; for the Sun once from rifing in the North-Eaft-by-Eaft, will pafs over the Meridian with 3½ Degrees of North Declination, and fet due North; which will make the Afternoon fomewhat above four Hours longer than the Forenoon; and the next Morning the Sun will rife at 2 o' Clock, 21½ Degrees Eaft of the North, or about the North-North-Eaft. As to what would happen on the other Days concerning

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the Sun's Rifing and, I fhall not take any further
Notice of it; but, if the Inhabitant will travel Eaft-
ward 37½ Degrees, ftill upon the fame Parallel of
Latitude, he will fee the Sun, at making his firft
Appearance from the Southern Tropic, rife due
South at 12 o' Clock; and. getting about half a De-
gree above the Horizon, when he has gone forward
about 9 Degrees, he will then defcend, and fet about
a Quarter after 1 : So there is only an Hour and a
Quarter in the firft Day of the Sun's Appearance ; and
the fecond Day will be 11 Hours long; but the third
Day will be about 87 Hours long; for the Sun will
make 3 Revolutions and fomewhat more than an
half without fetting : The fourth Day will be
11 Hours long ; and the fifth will only contain an
Hour and a Quarter; for the Sun will rife about 18
Degrees Eaft of the South, and fet in the South
Point of the Horizon.

16. We will now fuppofe that the Spectator has
travelled from 45 Degrees of North Latitude, to the
Equator, and has a Mind to take a Tour round the
fame, becaufe the *Phænomena* will be very different
in different Parts thereof ; tho' the Sun will rife and
fet to every Part of it, in every apparent Revolution;
but we fhall only confider in general what happens
at two Places thereof: The firft Place fhall be that,
where the firft Meridian croffes the Equator ; and the
fecond, a Place 112½ Degrees Weftward of the firft.
To each of thefe Places the Sun will always rife at 6,
and fet at 6, tho' fometimes his Meridian Altitude may
be 11 Degrees more or lefs than his Midnight Depref-
fion ; and in other Places the Difference will amount
to 15 or 16 Degrees; fo that, if the diurnal and
nocturnal

nocturnal Spirals of the Sun's Motion on the Body
of this Planet were meafured, the one would very
much exceed the other. To the firft of thefe two
Places the Sun will rife 74 Degrees South of the Eaft
in coming from the Southern Tropic, and fet $61\frac{1}{2}$
South of the Weft, having been 22 Degrees high at
Mid-day, and will be $32\frac{1}{2}$ deprefs'd below the Horizon
at Midnight. The next Day he will rife 44 Degrees
South of the Eaft, and fet 26 Degrees South of the
Weft; having been 55 Degrees high at Noon, and
will be $74\frac{1}{2}$ deprefs'd at Midnight. The third Day he
will rife $7\frac{1}{2}$ Degrees South of the Eaft; and croffing
the Equator at half an Hour after 10 o' Clock, he
will, in $7\frac{1}{2}$ Hours after, fet 12 Degrees North of the
Weft; and fo proceed, changing his rifing and fet-
ting Amplitude every Day, in advancing toward the
Northern Tropic, till he reaches it; and then his
fetting Amplitude, in going from it, will be the fame
as his rifing Amplitude in coming toward it. In the
fecond Place, all I fhall take notice of, is, that
the Sun, in coming from the Southern to the
Northern Tropic, will crofs the Equator at 9 o'Clock
at Night; and, in going from the Northern to the
Southern Tropic, he will crofs the Equator at Mid-
day.

17. At the Equator the Sun's Rays will be as ob-
lique, when his Declination is greateft, as they are at
London, when he touches the Tropic of *Capricorn* in
December; becaufe the Tropics of *Venus* are as far from
each Side of her Equator, as the Tropic of *Capricorn* is
from the Parallel of *London* on our Earth: Therefore,
at *Venus*'s Equator, there will be two Winters, two
Springs, two Summers, and two Autumns, every
Year:

Year: And becaufe the Sun ftays for fome time near the Tropics, and paffes fo quickly over the Equator, every Winter there will be about twice as long as Summer : But, becaufe of the quick Return of Summers, and the general Heat on the Body of *Venus*, the Winters there will be very mild; and fo will make the Equator, and all Places thereabouts, very temperate, and fit for Habitation.

18. Thofe Parts of *Venus* which lie between the Poles and Tropics, and between the Tropics and polar Circles, and alfo between the Polar Circles and Equator, will more or lefs participate of the *Phænomena* of thefe Circles, as they are more or lefs diftant from them.

19. The Places of the Equinoxes and Solftices on the Body of *Venus* go backward, or from Eaft toward the Weft, 90 Degrees every Year, This is not occafioned by any Mutation of her *Axis* from its Parallelifm; but by the Sun's being a Quarter of a Day later in croffing the Equator every Year, than on the Year before; and therefore he will crofs it in a Place 90 Degrees Weftward of the former every Year : So that to any Place where he croffes the Equator at Noon, he will, on the Return of that Day at Noon in the next Year, be almoft 10 Degrees South of the Equator, and will crofs it at 6 in the Evening; fuppofing the Year to begin when the Sun is on the Equator, in paffing from the Southern Tropic to the Northern. Hence, tho' the Spiral, in which the Sun's apparent Motion is performed, be of the fame Sort every Year, yet it will not be the very fame; becaufe the Sun will pafs vertically over all the fame Places but once in every four Years : And, in the above Defcription, I

T   have

have only ſhewn what will happen in general, for
one Year; having only drawn the Spiral of the Sun's
Motion for that Time: And if a Spectator, on any
Parallel of Latitude, ſhould want to ſee the ſame
Appearances of the Sun's Riſing and Setting every
Year, and, conſequently, to have the particular Days
thereof to be ſtill of the ſame Length with thoſe of
the Year, he muſt travel Weſtward every Year 90
Degrees on the ſame Parallel.

20. The Inhabitants of *Venus* will be very careful in
adding a Day to ſome particular Part of every fourth
Year, to keep ſtill the ſame Seaſons to the ſame
Times; becauſe, as the great annual Change of the
Equinoxes and Solſtices will ſhift the Seaſons forward
a Quarter of a Day every Year, they would, in 36
Years, ſhift the Seaſons forward thro' all the Days of
the Year: But, by this intercalary Day, every fourth
Year will be a Leap-Year; which will bring her Time
to an even Reckoning, and keep her Calendar right.

21. The great Change of the Sun's Declination
every Day, which cauſes his Altitude, at Noon, or
any other Hour, and his Amplitude at Riſing and
Setting, to be ſo very different in Places lyiug under
the ſame Parallels of Latitude, will be of one ſingu-
lar Uſe in *Venus*, the like whereof we ſhall never
enjoy on the Earth; and that is no leſs than the giv-
ing a ſure and eaſy Method of finding the Longitude.
For, ſuppoſe to one Place, at Noon, the Sun's De-
clination is 30 Degrees, and to another Place it is,
only 20 Degrees 35 Minutes at Noon, in the ſame
revolutional Spiral, going from the Equator toward
the Northern Tropic; the Difference of theſe two
Declinations is 9 Degrees 25 Minutes: In the ſame
Spiral

Spiral from the Equator, where any Meridian croſſes it, to the ſame Meridian again, the Declination changes from nothing to 37 Degrees 21 Minutes; and the Sun has gone 38 Degrees 55 Minutes in the Ecliptic. Theſe Things being known, the Proportion will be thus; As 7: Degrees, the greateſt Declination, is to the Sun's Motion in that Time, which is 3 Signs, equal to $2\frac{5}{16}$ Revolutions round *Venus*; ſo is 9 Degrees 25 Minutes (the Difference of Declination at two given Places) to 9 Degrees 44 Minutes, which is a fourth Part of a Revolution; and therefore the one Place is a fourth Part of a Circle, or 90 Degrees of Longitude diſtant from the other: And, as the Declination was advancing from the Equator toward the Northern Tropic, the Place, in whoſe Meridian it was 20 Degrees 35 Minutes, is Eaſtward from the Place in whoſe Meridian it was 30 Degrees, ſuppoſing them both to be in the Northern Hemiſphere.

I ſhould be very glad to ſee this Deſcription examined into, and put in a better Form, by ſome whoſe Abilities are much greater than mine: And altho' it ſeems ſtrange, at the firſt View, that the great Inclination of *Venus*'s *Axis*, with her ſlow diurnal and quick annual Motion, ſhould make ſuch mighty Differences of her *Phænomena* from the Earth's; yet I verily believe, that, was the Spiral of the Sun's Motion for four Years, which would contain 37 Revolutions, nicely drawn on a large Globe, and the Times mentioned in which the Sun would riſe and ſet, with his different Amplitudes, Altitudes, and Declinations, where the Effects thereof would differ conſiderably in many particular Parts of each Spiral;

and

and so occasion remarkable Differences of the Lengths of Day and Night, in the same Revolutions, to Places under the same Parallels of Latitude; a whole Volume might be wrote in the Description, if the Author would descend to Particulars.

VII. *A* Machine *for* founding the Sea *at any Depth, or in any Part, invented by Major* Wm. Cock *in the Year* 1738. *in a Voyage to* Georgia.

Presented April 10. 1746.

THE Draught of·this Machine is exhibited in TAB. II. *Fig.* 1. wherein

AAAA represent a Trunk of Timber, with a square Hollow, thro' the Centre of which passes the square Piece of Timber *BB*.

A Groove on each Side, in which are placed the two Pieces of Iron *CC*; the Foot of each resting on the Pins *DD*, that pass thro' the Trunk; the upper Part of the Irons are hooked to an iron Pin at *E*, which passes thro' the square Piece *BB*; which Piece is hollowed between *H* and *H*, for the Hooks of the Irons *CC* to pass up and down.

When the Weight *F* touches the Ground, the two Irons *CC* sink the Trunk to *G*, which unhooks them at *E*; whereupon they fall off, and leave the Trunk at Liberty to float or rise up again to the Surface.

A Machine of these Dimensions, loaded with an iron Ball, *F*, of 12 Pounds Weight, being let down

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